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NASA TECH BRIEF

Marshall Space Flight Center

Isolated-Line Commutator-Amplifier

A commutator device with nearly ideal characteristics combines several individual signal-input lines into a single output line. Originally designed for solid state imaging mosaics, the commutator may be easily modified to suit any situation in which several low-level signals must be merged into one output. Among its desirable characteristics are: low input impedances, high output impedance, very high forward-to-reverse transmission ratios, and minimal gating spike coupling to either the inputs or the output. Multiple signal inputs can be connected to the output sequentially by successive gating, or simultaneously by algebraic summing, and the input lines will remain essentially uncoupled. The commutator also has high resistance to nonselected inputs and very low noise generation, characteristics which are required for applications involving very weak signals.

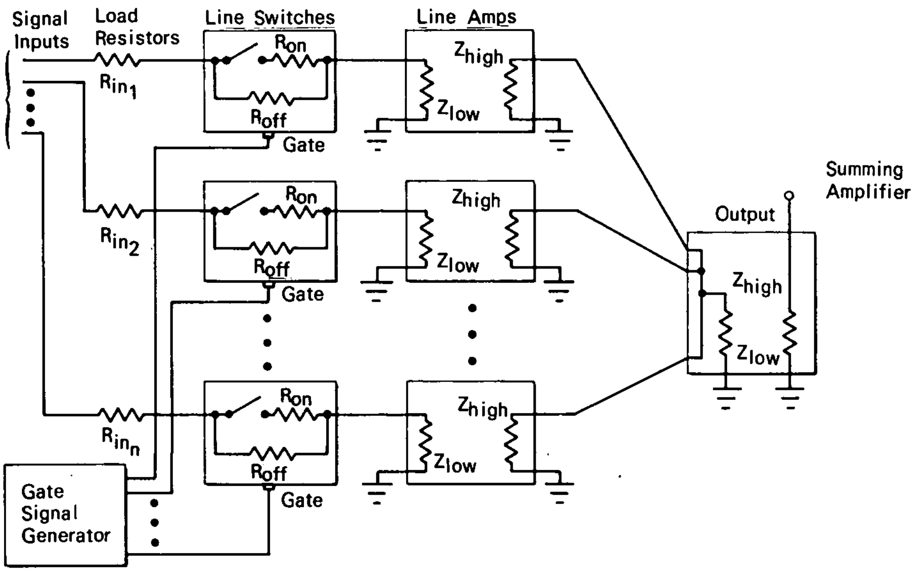

Figure 1. Block Diagram of Commutator

Figure 1, a block diagram of the isolated-line commutator, shows the primary novelty of the device; i.e., the use of unity-gain, impedance-transforming amplifiers in each signal line, as opposed to individual load resistors used in prior designs with only limited success. The line loads are the resistors R_{in}, located at the input to reduce the effect of variable forward switch conductance (R_{on}) so that all input lines see the same load. Since each switch output is fed into the very low input impedance of the unity-gain line amplifiers, the conductance of all switches is independent of the input signal level. The forward-to-reverse transmission ratio is further maximized by the amplifiers.

Figure 2 shows the circuit configuration used in the existing commutator design. Circuit details may be modified to suit the requirements of a given

(continued overleaf)

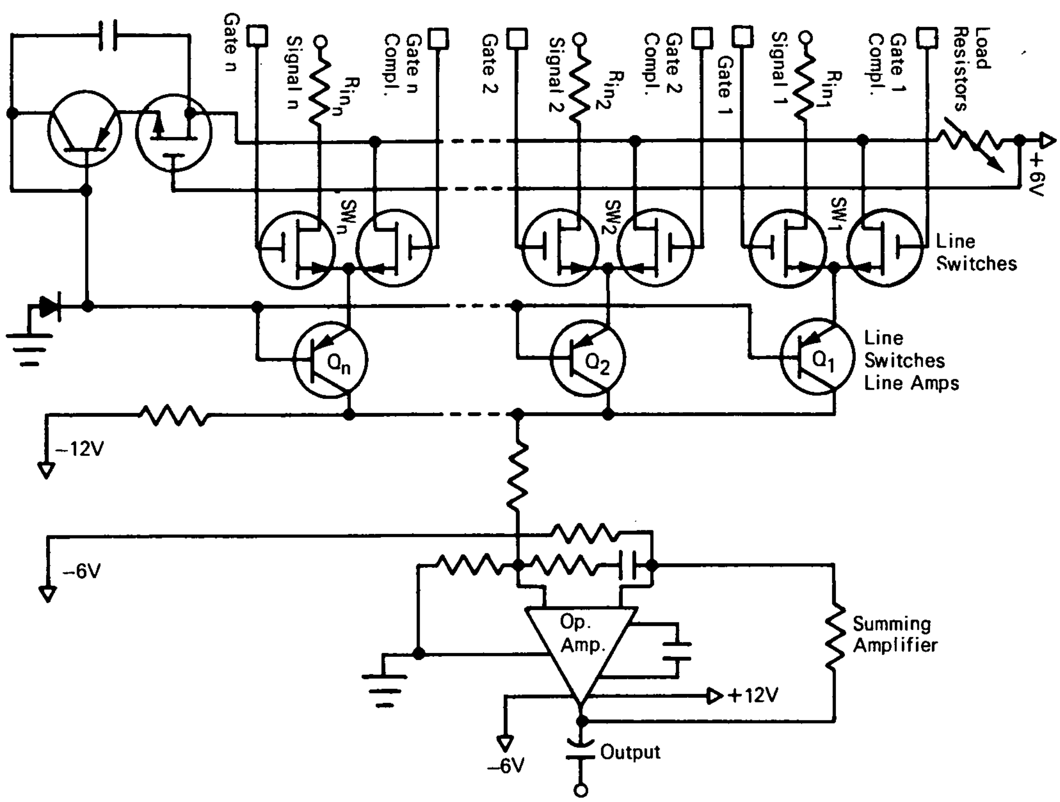

Figure 2. Schematic of Commutator

application. Metal oxide semiconductor (MOS) devices are used in the line switches to obtain low levels of gate-to-signal-line leakage and spiking interaction. These components exhibit essentially no dc gate leakage, and the circuit arrangement makes symmetrical switching spikes available through each device. These may then be effectively cancelled at the summing point if the signal inputs are gated in a continuous sequence with no time lapse between selection periods. If dead intervals are to exist between gates, the circuit may be modified to use complementary devices in each switch, so that spike cancellation will occur at the input to the individual line amplifiers.

The common-base line amplifiers were selected because of their very low input impedances and because their emitters never rise more than one diode drop above the base reference voltage. By referencing the bases one diode drop below ground, the emitters are essentially held at ground potential. This configuration holds the source leads of the MOS switches at a constant voltage and allows full use of the switching device characteristics for any particular gating-signal level.

With the circuitry shown, the commutator will respond to positive-going input signals only. The lower voltage limit may be modified by changing the base reference voltage, or the system may be converted to respond to negative-going signals by inverting all supply voltages and replacing n-type devices with p-types, and vice versa.

Notes:

1. Since nearly all of the circuitry associated with the commutator consists of active, solid state devices, the innovation should lend itself readily to MSI or LSI techniques.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   Code A&TS-TU
   Marshall Space Flight Center
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   Reference: B71-10148

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Mail Code A&TS-PAT
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